Cem 151
Exam 2
October 16, 2014

Choose the best answer from the choices (5 points each)

1) The net ionic equation for formation of an aqueous solution of NiI_2 accompanied by evolution of CO_2 gas via mixing solid $NiCO_3$ and aqueous hydriodic acid is _____.

(a) $2NiCO_3\ (s) + HI\ (aq) \rightarrow 2\ H_2O\ (l) + CO_2\ (g) + 2Ni^{2+}\ (aq)$
(b) $NiCO_3\ (s) + I^-\ (aq) \rightarrow 2\ H_2O\ (l) + CO_2\ (g) + Ni^{2+}\ (aq) + HI\ (aq)$
(c) $NiCO_3\ (s) + 2HI\ (aq) \rightarrow 2\ H_2O\ (l) + CO_2\ (g) + NiI_2\ (aq)$
(d) $NiCO_3\ (s) + 2H^+\ (aq) \rightarrow H_2O\ (l) + CO_2\ (g) + Ni^{2+}\ (aq)$
(e) $NiCO_3\ (s) + 2HI\ (aq) \rightarrow H_2O\ (l) + CO_2\ (g) + Ni^{2+}\ (aq) + 2\ I^-\ (aq)$
(f) None of the above

2. Which of the following are strong electrolytes?

(a) hydroiodic acid	(d) acetic acid	**(g) a, b, c**	(j) b and c
(b) sodium hydroxide	(e) chlorous acid	(h) a, b, c and e	
(c) ammonium chloride	(f) all of the above	(i) none of the above	

3. How many milliliters of a 4.2 M solution of ammonium sulfate must be added to water to make 2.0 liters of a 0.20 M solution of ammonium sulfate.

(a) 48 mL	(c) 200 mL	(e) 42 mL	(g) none of the above.
(b) 95 mL	(d) 400 mL	(f) 420 mL	

4. Which one of the following solutions will give the most strongly basic solution (assume complete solubility of all species)?
(a) 100 mL of 0.2 M sulfuric acid solution added to 50 mL of a 0.5 M magnesium hydroxide solution
(b) 150 mL of a 0.2 M hydrochloric acid solution added to 50 mL of a 0.5 M magnesium hydroxide solution
(c) 100 mL of 0.3 M ammonia added to 50 mL of a 1.6 M sodium hydroxide
(d) 0.025 M beryllium hydroxide
(e) 0.100 M hydrochloric acid
(f) None will produce hydroxide ions

5. How many grams of sodium bicarbonate must be added to make 1 L of a 1.5 M solution?

(a) 107 g	**(c) 126. g**	(e) 168 g	(g) none of the above

(b) 160.5 g (d) 124.5 g (f) 166 g

6. Calculate the molarity of an acetic acid solution if 34.57 mL of this solution are needed to neutralize 25.20 mL of 0.1025 M sodium hydroxide.

(a) 0.1494 M (c) 0.7470 M (e) 0.02356 M
(b) 1.494 M **(d) 0.0747 M** (f) none of the above.

7. Determine the change in oxidation number for C, H and O going from reactant to product for the following reaction:

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

(a) 4,1,2 **(c) 8,0,-2** (e) 0,0,0 (g) -8,0,2
(b) 4,1,-2 (d) 8,0,2 (f) 2,0,2 (h) none of the above

8. Which of these species will be reduced by lead (hint a table of activities is included)?

(a) Li^+ (c) Na^+ (e) Fe^{2+} (g) H_2 (i) none of the above
(b) Zn^{2+} (d) Cu(s) (f) iron **(h) H^+**

9. Several teenagers drop various fruits from a bridge onto the traffic below. The bridge is 15 meters above the cars. While un-ripened oranges bounce off disappointingly, tomatoes are found to give a most satisfying splat. Assuming that 10.% of the energy is lost as heat, and a tomato weighs 200. g, how much work is done on the tomato to give the satisfying splat? Remember, F = ma, where a = 9.8 m/s^2 and w = F·d.

(a) 15 J (c) 29 J (e) 200 J
(b) 22 J **(d) 27 J** (f) 180 J

10. A piston has an external pressure of 5.0 atm. How much work was done by the piston on the surroundings if the volume of the cylinder goes from 0.140 to 0.550 L?

(a) 2.05 L·atm (c) 5.0 J **(e) -2.05 L·atm** (g) -5.0 J
(b) 2.05 J (d) 5.0 L·atm (f) -2.05 J (h) -5.0 L·atm

11. The value of $\Delta H°$ for the reaction below is -126 kJ. _____ kJ are released when 2.00 mol of NaOH is formed in the reaction.

$$2\ Na_2O_2\ (s) + 2\ H_2O\ (l) \rightarrow 4NaOH\ (s) + O_2\ (g) \quad \Delta H° = -126$$

(a) 252 (c) 378 (e) 126 (g) 720 (i) 7.8
(b) 63 (d) 15.6 (f) 680 (h) 232

12. 13.9 g of lithium metal is reacted with excess hydrochloric acid to produce Hydrogen gas and lithium ions. Calculate the amount of work done by the reaction. Assume that 22.4 L of hydrogen is produced for every mole and the pressure is 1 atm.

$2Li(s) + 2HCl(aq) \rightarrow 2LiCl(aq)s + H_2(g)$

(a) -22.4 L-atm	(c) -66.8 L-atm	(e) -11.2 L-atm	(g) -44.8 L-atm
(b) -44.8 L-atm	(d) -14 L-atm	(f) 22.4 L-atm	(h) -66.8 L-atm

13. The frequency of green light is approximately 6×10^{14} s^{-1} and the frequency of violet light is approximately 7.5×10^{14} s^{-1}. How many photons of violet light have the same total energy as 10 photons of green light?

(a) 1	(c) 3	(e) 5	(g) 7	(i) 9
(b) 2	(d) 4	(f) 6	**(h) 8**	(j) 10

14. Put the following forms of electromagnetic radiation in the order of their frequency from lowest to highest:
X-rays, radio waves, ultraviolet radiation, infrared radiation, visible light.

(a) visible, infrared, ultraviolet, X-rays, radio waves
(b) infrared, visible, ultraviolet, X-rays, radio waves
(c) infrared, ultraviolet, visible, X-rays, radio waves
(d) radio waves, infrared, visible, ultraviolet, X-rays
(e) X-rays, ultraviolet, visible, infrared, radio waves

15. Electron microscopy involves imaging of objects on a very small scale using a beam of electrons. It demonstrates which of the following phenomenon

(a) The photo-electric effect
(b) The Debrogle wave/partical duality
(c.) The existance of the nucleus
(d) Black body radiation
(e) The quantization of light energy
(f) The fact that energy is a state function

16. Which of the following experiments demonstrated the existence of the nucleus?

(a) J. J. Thompson's cathode ray tube and mass spectroscopy
(b) Muliken's oil drop experiment
(c) The photo electric effect.
(d) The Rutherford gold foil experiment
(e) The discovery of radium

17. Standing waves have certain properties that make them good models for electrons bound to atoms. Which of the following represent those properties:

(a) The frequency of a standing wave is quantized
(b) The wave-like nature of electrons make it possible to describe them as standing waves.
(c) The wavelength of a standing wave is quantized.
(d) The energy of the standing wave of an electron can be quantized using the DeBroglie hypothesis.
(e) None of the above
(f.) All of the above

18. Which of the following represent allowed values of the four quantum numbers, n, l, m_l, m_s?

(a) 2, 0, -1, ½
(b) 1, 2, -1, ½
(c) 2, 2, 2, ½
(d) 1, 1, 1, ½
(e) 2, 1, -1, ½
(f) 3, 3, -1, ½

19. (15 points) From the following thermochemical equations, calculate the enthalpy of formation of CH_4

$CH_4 + 4F_2 \rightarrow CF_4 + 4HF$	dH = -1942 kJ/mol
$C(graphite) + 2F_2 \rightarrow CF_4$	dH = -933 kJ/mol
$H_2(g) + F_2(g) \rightarrow 2HF(g)$	dH = -542 kJ/mol

-75 kJ

20. (15 points) The following acid-base reaction is performed in a coffee cup calorimeter:

$HCl\,(aq) + NaOH(aq) \rightarrow H_2O(l)$

The temperature of 110 g of the solution rises from 25.0°C to 26.2°C when 0.10 mol of HCl is reacted with 0.10 mol of NaOH (assume the specific heat of the solution to be 4.184 J/Kg).

- Calculate q_{water}
- **550 J**
- Calculate ΔH for the reaction
- **-5.5 kJ**
- Calculate ΔH if 1.00 mol NaOH reacts with 1.00 mol HCl

-5.5 kJ

21. (15 points) Draw diagrams of the following orbitals (what the orbitals *look like in space)*:

a. a 1s and 2s orbital

b. A $2p_y$ and $2p_x$ orbital

c. Three of the five 3d orbitals

Metal	Oxidation Reaction
Lithium	$Li(s) \longrightarrow Li^+(aq) + e^-$
Potassium	$K(s) \longrightarrow K^+(aq) + e^-$
Barium	$Ba(s) \longrightarrow Ba^{2+}(aq) + 2e^-$
Calcium	$Ca(s) \longrightarrow Ca^{2+}(aq) + 2e^-$
Sodium	$Na(s) \longrightarrow Na^+(aq) + e^-$
Magnesium	$Mg(s) \longrightarrow Mg^{2+}(aq) + 2e^-$
Aluminum	$Al(s) \longrightarrow Al^{3+}(aq) + 3e^-$
Manganese	$Mn(s) \longrightarrow Mn^{2+}(aq) + 2e^-$
Zinc	$Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$
Chromium	$Cr(s) \longrightarrow Cr^{3+}(aq) + 3e^-$
Iron	$Fe(s) \longrightarrow Fe^{2+}(aq) + 2e^-$
Cobalt	$Co(s) \longrightarrow Co^{2+}(aq) + 2e^-$
Nickel	$Ni(s) \longrightarrow Ni^{2+}(aq) + 2e^-$
Tin	$Sn(s) \longrightarrow Sn^{2+}(aq) + 2e^-$
Lead	$Pb(s) \longrightarrow Pb^{2+}(aq) + 2e^-$
Hydrogen	$H_2(g) \longrightarrow 2\,H^+(aq) + 2e^-$
Copper	$Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$
Silver	$Ag(s) \longrightarrow Ag^+(aq) + e^-$
Mercury	$Hg(l) \longrightarrow Hg^{2+}(aq) + 2e^-$
Platinum	$Pt(s) \longrightarrow Pt^{2+}(aq) + 2e^-$
Gold	$Au(s) \longrightarrow Au^{3+}(aq) + 3e^-$